Integrated Pest Management (IPM)

Definition of IPM

Pest management is a system of plant protection which utilize all suitable techniques to reduce and maintain pest population at levels those causing injury of economic significance to agriculture and forestry.

A system which brings together all feasible method of pest control, harmonizing them into a single unified and co-ordinate system designed to maintain pest at levels below those at which they cause economic loss.

Pest management is the intelligent selection and use of pest control action that will ensure favourable economic, ecological and sociological consequence. The practices of pest management has been described by Geir (1966) as;

a. Determining how life system of a pest needs to be modified to reduce its number to tolerable levels that is below the economic threshold.

b. Applying biological knowledge and recent technology to achieve the desired modification that is applied ecology.

c. Revising procedures for pest control selected to current technology and compatible with economic, environmental and social acceptance.

Benefits of IPM

1. IPM increases crop yield and farmers income.

2. The use of insecticides may be reduced up to 80% of total use of crop yield may be increased upto 10% through IPM.

3. IPM conserves ecosystem and ensures reliability and stability of farm output.

4. IPM reduces the risk of farmers and the public.

5. It helps farmer to become self reliant.

6. It helps to reduce the national expenditure for pesticides.

7. IPM reduces health care cost.

8. It increases the savings of farmer.

9. IPM directly helps to increasing farmers income.

Disadvantage of IPM

However, IPM does have some disadvantages. These include:

1. More involved planning.
2. More family decision-making.
3. More demanding lawn and garden care.
4. More resources needed as substitutions for pesticides.
5. Requires a greater amount of outside knowledge.
6. Time and energy consuming.
7. More involvement in the technicalities of the method

Some problem associated with the use of pesticides

1. Pesticides causes the health hazards.
2. Pesticides are extremely unfriendly to the environment.
3. Pesticides destroy the beneficial organism and increased the pest population.
4. Reported application of pesticides makes the pest resistance to insecticides.
5. Pesticides affect the soil fertility.
6. It may create new pest problem.
7. It increases the input cost.

Methods of IPM

Integrated Pest Management is based on following different components.

A. Cultural control.

B. Mechanical control.

C. Biological control.

D. Physical control.

E. Chemical control.

A. Cultural Control

Cultural method is the prevention or reduction of injurious insect pest by utilizing or changing various farm practices in an intelligent manner. Cultural method of insect control comprise the regular farm operations so performed as to destroy the insect or to prevent them from causing injury.

For the achievement of cultural control the following agricultural practices are to be done:

1. Use of resistant varieties: The use of resistant varieties is an important practices of cultural control. There are certain varieties of crops that are attacked less by a given insect than others because of presence of natural resistant to these pest attack. e.g. Deshi cotton much more resistant to attack of white fly and the bollworm than the American cotton. So, insect pest attacked can be checked by using resistant varieties.

2. Crop rotation: Generally certain insect attack certain crops. So, infestation of most of the insect are reduced/checked by following crop rotation. e.g. The infestation of stem borer of rice may be checked by cultivating jute after rice. Similarly, Jute hairy caterpillar can be controlled by cultivating rice after jute.

3. Crop residues destruction: Some insect, e.g. stem borer of rice and sugarcane, cucurbit beetles etc. stay in crop residues and attack the next season crop. So, such insects are controlled by destroying the crop residues after harvesting the crops by burning.

4. Tilling and cultivating the soil: Most of the soil infesting insect are controlled by changing the soil characteristics (texture, composition, temperature, humidity etc) which direct influence the survival of those insects. Those sub-terrestrial insect are exposed to sunlight through tilling and cultivation of soil. Adults and most of larvae; most sub-terrestrial insects are picked up by their natural enemies such as birds or other predators.

5. Pruning and thinning: Some pest are normally carried from the old portion to new one. It is particularly seen in fruit trees. Proper pruning of the undesirable portion of such plant is useful for keeping under check those insect attack. e.g. Leaf minor red scale of citrus, apple aphid and the peach leaf curl, aphid of stone fruits are controlled through pruning. The infestation of some insect pest are controlled by thinning the crop plant. e.g. Infestation of green leaf hopper of rice can be reduced by the thinning of rice plants.

6. Fertilization: Healthy and vigorous plants are resist to the attack of a given pest better than the sickly undernourished plant. Plant growth can be stimulate with balanced fertilization. So infestation of some insect may be reduced through balanced fertilization. e.g. Application of nitrogenous fertilizer reduce the incidence of white fly of cotton.

7. Clean culture: Clean culture means the removal of all undesired plant, plant debris and other materials from the fields and only growing healthy crops. Most of the insect which

survive or take shelter all those undesired plant in the field in the season (off time) may be controlled by removing them.

Moreover, Larvae of Rhinoceros beetle are live in cowdung. Epilachna beetle, red pumpkin beetle etc. are remain in dried leaves. So clean cultivation is necessary to control those insect.

8. Water management: Some insect controlled by applying irrigation or draining water from the field. Most of the sub terrestrial insect such as Cutworm, termite, sugarcane white grubs etc. are controlled by providing flood irrigation. As a result of flooding, some are drowned and some of others are driven out and exposed to their natural enemies. Again, the infestation of some insect, e.g. Rice Caseworm are prevented by draining out water from the field.

9. Planting of trap crops: Polyphagous insect are controlled by planting of trap crops. In this case most susceptible crops to particular polyphagous insect are grown around or in the field of main crops. e.g. Lady's finger are planted around or center of the cotton field to control the jassids and spotted Bollworms as trap crops.

10. Use of clean seed: A number of insect pest are carried over from one crop to next through seeds, cutting or other infested plant parts that used for propagation. e.g. pink bollworm of cotton attack the crop in next season remaining in cotton seeds as dormant pupa. Again citrus scale insect in the branches of citrus plant which attack the plant in next season. Therefore, certified seeds free from pest and disease should be used for raising a new crop.

11. Variation in time of plant and harvesting: Variation of time of plant can help to reduce pest infeastation. e.g. Early sowing in jowar escapes the shoot fly attack while early planting in rice reduces gall midge damage.

12. Earthing up: Sugarcane early shoot borer, potato tuber moth can be controlled by timely earthing up of the field. This prevents insects to lay their eggs.

Advantages

1. As we are using same cultural practices no extra cost is required.

2. This method is safe for application.

Disadvantages

1. This method is effective for single pest only.

2. There are no visible results observed.

3. This method is not effective at epidemic condition.

4. Detailed knowledge of biology of pest is required for this purpose.

B. Mechanical control

Mechanical pest control is the management and control of pests using physical means such as fences, barriers or electronic wires. It includes also weeding and change of temperature to control pests. Mechanical control can be accomplished as the follows-

1. Handpicking: The use of human hands to remove harmful insects or other toxic material is often the most common action by this method. Insect can be hand picked and destroyed of their easily accessible to the pickers large and conspicuous and present in large number of clusters. e.g. Egg mass of rice stem borer, early larval stage of jute hairy caterpillars, adult of sugarcane stem borer etc. can be maintained by hand and destroyed.

2. Use of hand net and bag nets: Some adult insect can be collected and destroyed with hand nets. e.g. Green leaf hopper, Grasshoppers etc. can be controlled with hand nets when they migrate in April-May from maize to sugarcane. The bag nets can be used to control the some insects. e.g. Rice hispa from the field partially.

3. Beating and hooking: Various household pest like as housefly, cockroach etc. can be killed by beating with brooms, flappers etc. Again some pests which hide in the holes or crack of host such as Rhinoceros beetle, Jackfruit beetles etc. are killed by hooking with the help of crooked hooks.

4. Shaking and garring: Different insect such as cotton bug, mango shoot borer & defoliator etc. can be killed by shaking the small trees or shrubs. Particularly, every in the morning in cold season when insect are remain in the tree and collecting them tab containing kerosinized water or by hand crashing or leg crushing.

5. Sieving and winnowing: These method are commonly used against stored grain pest. Some insects, e.g. Red flour beetle are destroyed by collecting them through sieving and some insects. e.g. Rice weevil are destroyed by collecting them winnowing.

6. Mechanical Exclusion: Some of the insects are controlled by creating a barriers for insects in reaching the place where they causes. e.g. Application of a band of sticky material like 'Ostico' or a band of slippery sheets like alkathene around the trunk of a mango tree to prevent the upward movement of the mango mealy bug. Using of screens over the windows, doors and ventilators of house to keep away houseflies, Mosquitoes, bugs etc. Making trench of 30 cm depth around the field and applications on jute hairy caterpillar, Jute Semilooper from infested area to new field; using red light in the monsoon to keep away most of insects.

7. Use of mechanical traps: Various type of traps have been used for collecting and killing different type of insect-

I) Light trap- Light trap can be used to attract and kill the nocturnal insects. e.g. Leaf hopper, Jute hairy caterpillar, moths, stem borer of rice etc. An electric bulb or a lamp is place in the

wide flat vessel containing kerosinized in which the moth, beetles get drowned.

ii) Air suction trap- Air suction trap used to against stored grain pest in godown.

iii) Electric trap- Like metal screens are used on which birds or insects are electrocuted.

8. Burning: Locust can be killed by the burning with the help of flame torches. Stored grain pest are also controlled by burning.

9. Crushing and grinding: This devices are used for Sugarcane. Sugarcane shoot borer are controlled by harvesting the sugarcane and then crushing for obtaining sugar.

10. Sound production: This device are mainly used in scaring these birds which attack fruits and grain crops. This is also used to control some insects like mosquitoes. Male mosquitoes can be attracted to outside of house by producing sound of female mosquito from outside.

11. Rope dragging in field: Rice case worm larva pupate in case prepared by the leaves which remains attached to the plant and can be removed by the dragging rope. Due to this case can fall in the stagnating water and removed easily.

12. Banding the trees: Mealy bugs on mango comes on soil for egg laying which can be prevented by putting sticky bands on stem.

13. Bagging the fruits: Fruit sucking moth on citrus or pomegranate suck the juice with the help of stout which can be prevented by bagging fruits.

14. Trenching the field: Pest like army worm, grasshoppers march from one field to other which can be prevented by trenching in field.

15. Tin collars on stem: rat can climb on coconut tree and damage the fruits. When we put the tin collars on stem they can not climb.

Advantage

1. Skilled labours are not required.

2. Cost required is very less.

3. There are no any side effects.

Limitations

1. Time and labour requirement is high.

2. This method is applicable only on small scale.

3. This requires repeated application.

C. Biological Control

Biological control is a method of controlling pests such as insects, mites, weeds and plant diseases using other organisms. It relies on predation, parasitism, herbivory or other natural mechanisms but typically also involves an active human management role. It can be an important component of integrated pest management (IPM) programs. Biological control can be accomplished as the follows-

1. Predators

Organisms which feed on other insects having body size greater or equal to the insect is called predators. Predators catch and eat their prey. Some common predatory arthropods include lady bird beetles, carabid (ground) beetles, staphylinid (rove) beetles, syrphid (hover) flies, lacewings, minute pirate bugs, nabid bugs, big-eyed bugs, and spiders. e.g. Lady bird beetle feeds on aphids, *Chrysoperia carnea* insect feed on all soft bodied insects like aphids, jassids, white flies, mealy bug, etc. *Cryptolaemus montrouzieri* insect feeds on mealy bugs on grapes.

2. Parasitoids

Those insects whose larvae feed internally or externally on the body of other insect is called parasites. Most insect parasitoids are wasps or flies. Parasitoids (sometimes called parasites) do not usually eat their hosts directly. Adult parasitoids lay their eggs in, on or near their host insect. When the eggs hatch, the immature parasitoids use the host as food. Many parasitoids are very small wasps and are not easily noticed. *Encarsia formosa* is a small predatory chalcid wasp which is a parasitoid of whitefly. *Gonatocerus ashmeadi* (Hymenoptera: Mymaridae) has been introduced to control the glassy winged sharp shooter. Parasitoids often require a source of food in addition to their host insect, such as nectar or pollen. This also includes,

i) Egg parasite: *Trichogramma chilonis* parasites egg of *Helicoverpa armigera.*

ii) Larval parasite: *Bracon hibitor* parasites larvae of *H. armigera.*

iii) Pupal parasite: *Goniopthalmus halli* parasites pupae of *H. armigera.*

iv) Adult parasite: *Epiricania melanoleuca* parasites adults of sugarcane pyrilla.

v) Egg larval parasite: *Copidosoma kohleri* parasities egg of potato tuber moth and comes out at larval stage by killing the pest.

3. Pathogen

Biological control using pathogens is often called microbial control.

Bacteria: One very well-known microbial control agent that is available commercially is the bacterium *Bacillus thuringiensis* (Bt). *B. papillae* develops disease in coleopterous pests. The bacterium *Paenibacillus popilliae* causes milky spore disease has been found useful in the

control of Japanese beetle, killing the larvae. It is very specific to its host species and is harmless to vertebrates and other invertebrates.

Fungi: Several insect-pathogenic fungi are used as microbial control agents including *Beauveria*, *Metarhizium* and *Paecilomyces*. These are most often used against foliar insect pests in greenhouses or other locations where humidity is relatively high. *Beauveria bassiana* is used for control of lepidopterous pests. *Lecanicillium* spp. are deployed against white flies, thrips and aphids. *Metarhizium* spp. are used against pests including beetles, locusts and other grasshoppers, Hemiptera and spider mites. *Paecilomyces fumosoroseus* is effective against white flies, thrips and aphids; *Purpureocillium lilacinus* is used against root-knot nematodes and 89 *Trichoderma* species against certain plant pathogens. *Trichoderma viride* has been used against Dutch elm disease and has shown some effect in suppressing silver leaf.

Virus: Nuclear polyhedrosis viruses (NPV) and granulosis viruses (GV) are available to control some caterpillar pests. For example, the Lymantria dispar multicapsid nuclear polyhedrosis virus has been used to spray where larvae of the gypsy moth are causing serious defoliation. The moth larvae are killed by the virus they have eaten and die, the disintegrating cadavers leaving virus particles on the foliage to infect other larvae.

Algae: *Lagenidium giganteum* is a water-borne mould that parasitizes the larval stage of mosquitoes. As with all biological control agents, it is especially important to match the correct microbial control agent with the correct pest in order for them to be effective.

Protozoa: *Nosema bombysis* develops pebrine disease of silkworm. *N. apis* develops decentary in honey bee.

Nematodes: Among different groups of nematodes Mermithids causes disease in insect, this includes *Neoplectana carpocapsae* is commonly known as DD-136. This carries bacteria called *Acromobactor nematophilus* which develops disease in insect.

4. Competitors

The legume vine *Mucuna pruriens* is used to control for problematic *Imperata cylindrica* grass. The vine is extremely vigorous and suppresses neighbouring plants by out-competing them for space and light.

5. Combined use of parasitoids and pathogens

In cases of massive and severe infection of invasive pests, techniques of pest control are often used in combination. An example is the emerald ash borer, *Agrilus planipennis,* an invasive beetle from China, which has destroyed tens of millions of ash trees in its introduced range in North America.

Advantage

1. Highly specific to one pest.
2. A long term solution if equilibrium is established.
3. Inexpensive over the long term.
4. No environmental contamination.
5. Can be used in a glasshouse.

Disadvantage

1. Only a few working examples (Agents not known for most pests).
2. Expensive to research and a high level of skills and initial set up costs.
3. Agent may become a pest itself.
4. Frequent input needed to maintain population balance.
5. Needs to be large scale.

D. Physical Control

Reduction of pest population by using device which affect them physically or alter their physical environment. Manipulation of temperature, humidity, light is used for this purpose. This includes following types:

1. Application of heat: Super heating of empty godown to a temperature above 50^0C for 10-12 hours will kill the hibernating stored grain pest. Exposing in the infested grains to the sun on a pucca floor kills stored grain insect in the adult stage.

2. Application of Cold: Refrigeration at 5^0C of all eatables including dry fruits will kill the insect. The stored grain pest are also killed by exposing them to sub-zero temperature opening the doors and windows of godowns.

3. Manipulation of moisture: By raising lowering the moisture content of food and other materials. Unfavorable condition are created for insect pest. By draining away stagnant water to the maggot of mosquitoes are killed. Reducing the moisture content of grains below 80% would save them from most of insect. By soaking the logs in water over extended period (15 days) boring weevils are downward.

4. Sun drying: Stored grain pests can be easily controlled by sun drying.

5. Use of radiation: Ionizing radiation are used to make insect sterile and their by preventing their further generations.

6. Use of sound: Ultrasonic sound is used to control rats.

E. Chemical control

Use of synthetic chemicals for managing pest population is called chemical control and the chemicals used for this are called insecticides. Though there is a controversy of using chemicals due to environmental pollution it is a fact that this is the only method which is widely accepted and gave effective control of pest. It is also true that success of green revolution is possible due to chemicals only. IPM is most likely to be misunderstood as pest management without chemicals which in fact need based use of chemicals. Thus judicious use of chemicals that to when it is really required is recommended in case of IPM.

Advantages

1. This method is highly effective.

2. We can get quick results in this method.

3. We can observe visible death by chemical method.

4. This method can be used at variable climatic conditions.

5. There is wide range available for selection of chemicals.

6. This method is economic also.

Disadvantages

1. Repeated application of chemicals is required in this method.

2. Non target species like natural enemies of insect get affected.

3. Resurgence of minor pest is observed in this method.

4. There is problem of residue in food.

5. There is direct hazard to the applicator.

6. Continuous application of chemicals develops resistance in insect.

Attractants

A chemical which causes insect to make oriented movement towards its source is known as attractant.

Many insect depend for their survival follow an odour trial to a source of food to host plant and animals to the opposite sex or to the right place to lay eggs. Frequently they can be attracted by means of a chemical to a trap for detection purpose to a toxicant for control of injurious population. Such chemicals or substances are regarded as attractants.

The main functions of attractants is to attract insect towards them. Attractants may be other than chemicals. e.g. Sound which can be used to attract mosquito. In this case sound of female mosquito is produced and towards which male mosquito is attracted.

Type of Attractants

Attractants may be of following types-

A. Pheromones.

B. Food lures.

C. Oviposition lures.

A. Pheromones

The term pheromone was defined by Karlson and Butenandt (1959) to represent those chemicals that are secreted into the external environment by an animal and that elicit a specific reaction in a receiving individual of the same species. Pheromones are also known as ectohormones. Example of artificial pheromone are Geranil, Eugenol etc.

Types of Pheromones

1. Sex pheromone.
2. Alarm pheromone.
3. Trail-marking pheromone.
4. Aggregation pheromone or Arrestants.

1. Sex pheromones: The chemicals or pheromones that attract other insects towards them for mating are known as sex pheromones. Usually female insect secret sex pheromone and males attracted towards them. In over 150 species of insects, females have been found to release sex pheromones and about 50 species males produce. Most Lepidoptera female insect secrets sex pheromones. But some lepidopterous male insect can do this. e.g. The male of the cabbage looper produces sex pheromones. Usually different insect species secrets different sex pheromones. For example, monarch butterfly produces a sex pheromone named; trans, trans -10-hydroxy-3,7-dimethyl-2,6-decadienoic acid. Queen bee produces, 9-keto-2-decenoic acid.

2. Alarm pheromones: Alarm pheromones are those by which insects give warning signals to the other insects. In *Polistes exclamans,* alarm pheromones are also used as an alert to incoming predators. Social insect like honey bee, ants secret these pheromones. e.g. Ant produces, trans-β-Farnesene.

3. Trail-marking pheromones: Social insects commonly use trail pheromones. These are substances of low persistence elaborated by foraging ants and termites. They secret this pheromone on the way as a trail marker following which the other insects move on the same way. The ant (*formica rufa*) appears to use formic acid as a trail marker. The major trail marking pheromone of the Texas leaf cutting ant (*Atta texana*) is Methyl 4-methylpyrrole-2-carboxylate. Insect can be controlled by using these type of artificial pheromone.

4. Aggregation pheromone or arrestants: These are chemicals or chemical combination that cause insect to aggregate or congregate. Aggregation pheromones are released by one gender of a species to attract individuals (both sexes) of the same species in order to exploit a specific resource (food, appropriate mating site, etc.). Male-produced sex attractants often are referred to as aggregation pheromones because they typically result in the arrival of both sexes at a calling site. Aggregation pheromones have been found in members of the Coleoptera, Diptera, Hemiptera, Dictyoptera, and Orthoptera. The aggregation pheromone of khapra beetle (*Trogoderma granarium*), is reported to be a mixture of fatty acid esters, methyl and ethyl oleate, ethyl palmitate, ethyl stearate and ethyl linoleate.

B. Food lures

These are natural chemical substances present in many plant or animal host which direct the insect pest towards suitable site for feeding. Food lures may function as olfactory stimulants, producing orientation behaviour in which the insect travels upwind to the source in a manner, similar to the search for a source of sex pheromones. Specific example of food lures include 3-hexen-2-ol for the silkworm (*Bombyx mori),* sugar and propiononitrile for the housefly (*Musca domestica*), Coumarin for the sweet clover weevil etc.

By using food lures jute hairy caterpillar moth can be brought to the field of aus rice where they will lay eggs. After hatching the larvae will die due to lack of food.

C. Oviposition lures

These are natural chemical substances that control the selection of sites for oviposition by the adult female. By using these chemicals, adult female insect can be lured to lay egg in undesirable place where their larvae will die due to want of food. For example, p-methyl aceto phenone for the rice stem borer. By using this chemical substances, the adult female of rice stem borer can be brought to the jute field to lay egg where their larvae will die.

Use of pheromone in pest control

Pheromone may be used in pest control program in two possible ways-

1. Population density survey: Population density of a place or field can easily be known by using pheromone. As a result, the other control measure can be taken easily. Therefore, pheromone can be used to help insect control program.

2. Direct behavioural control: Pheromone can be used in direct behavioural control. Behaviour may be-

- ♦ Stimulational behaviour.
- ♦ Inhibitional behaviour.

In control insect, using pheromone insect should be oriented. In causing orientation pheromone, alone may be an orientation source or pheromone plus light can be used together. The later will give more effective result in causing orientation. The insect should be oriented to;

- An inappropriate host.
- A trap.
- Chemical source.
- Sterilization source.
- Preventive orientation.

Sometimes insect secrets preventive chemical substances by which an insect informs others to keep away. This pheromone is known as preventive orientation.

Repellents

The chemical which causes insect to make oriented movements away from its source is known as repellents. Repellents usually substances with a strong smell, act in the opposite way by keeping pest away.

Dethier (1947) has defined, repellents as those substance whose stimuli elicit avoiding reaction.

Repellents are chemicals, prevent insect damage to plants or animal by rendering them unattractive, unpalatable or offensive.

Types of repellents

There are two group of repellents which are-

A. Physical repellents: Physical repellents are water, dust, waxes, granular, oils, sound, smoke, heat, air current, movement of fan etc.

B. Chemical repellents: Oil of citronella and oil of camphor are widely used as mosquito repellents. Spraying of Bordeaux mixture comprising cupper sulphate and lime repels leaf hopper, fruit fly and some chewing insects. Dimethyl phthalate, β-naphthol, Benzyl benzoate etc. are used against mites. Diethyl toluidine provides protection against mosquitoes, ticks and fleas. Phenol is extremely used to drive bees from the hive. Besides, benzaldehyde, propionic anhydride, acetic acid etc. are also used to drive honey bees. Other cosmetically acceptable repellents in the form of cream, foam, lotions etc. are used to drive mosquitoes.

Antifeedants/Deterrents/Rejectants

Antifeedants are the chemicals which prevent feeding. Detheir et al (1960) proposed the term, feeding deterrent which aptly fits the situation as does possibly term rejectant.

Main functions of Antifeedants

They inhibit feeding but it not toxic to insect.

Chemical types of antifeedants

A. Triazenes: This group includes more than 80 antifeedants. They are tasteless, odourless, solid, nontoxic to insect. These antifeedants are mainly used against chewing type insect but they can also used to against bed bug, cockroach etc. e.g. 4-dimethyl triazinol acetanilide.

B. Organotins: e.g. Brestan has been found effective against the potato tuber moth larvae, larvae of Cutworm, sweet potato weevil etc.

C. Carbamates: e.g. Thiocarbamate and phenyl Carbamates with inhibit feeding by beetles such as potato beetle.

D. Botanical extract: Extract of fern can be used as antifeedants against army worms, extract of neem against stored grain pest.

E. Miscellaneous: Several unrelated types of chemical such as cupper stearate, copper resinate, phosphane, carvadan etc. can be used as antifeedants.

Mode of action of antifeedants

Apparently antifeedants inhibit the taste receptor of mouth region so that lacking of proper gustatory stimulus, the insect fails to recognized the treated leaves as food and continuous foraging. Unless the antifeedants comes in contact with these receptors, there is no inhibition of feeding.

Advantage

1. External feeder insect easily be controlled.

2. Antifeedants do not affect parasites, predators or pollinator like honey bee.

3. Its adverse effect is less on environment.

4. In using antifeedants, insect may turn from crops to weeds.

Disadvantage

1. Only external feeding insect are prevented from feeding and internal feeders, piercing and sucking insect proboscis burn are not affected.

2. Its action is not rapid and effective in comparison to insecticides.

3. Dosage also appears to be high, compared to insecticides.

Plant Resistance

Resistance of plants in insect is the property that enable a plant to avoid, tolerate or recover from injury by insect population that cause greater damage to other plants of the same species under similar environmental conditions. This property generally drives from certain biochemical or morphological characteristics of plants which so affect the behaviour and the metabolism of insects as to influence the relative degree of damage caused by these insects.

Plant resistance Mechanism

Mechanism of host plant resistance are-

1. Antixenosis.
2. Antibiosis.
3. Tolerance.
4. Escape mechanism.

1. Antixenosis: When a plant possess characteristics that make it unattractive to insect pest for oviposition, feeding or shelter. e.g. Aphid resistance in raspberry.

2. Antibiosis: When the host plant adversely affects the bionomics of the insect feeding on it.

3. Tolerance: When the damage to the host is only slight despite its supporting an insect population of a size sufficient to damage susceptible host severely.

4. Escape mechanism: The crop maturity and incidence do not coincide, therefore the host plant mature early and escape the incidence. For example, Early maturing cotton varieties escape pink bollworm infestation which occurs late in the season.

Factors responsible for plant resistance/Characteristics of plant resistance

A. Physical factors

1. Morphological factors

A number of morphological factors are given below-

i. Hairiness: Hairiness of leaves may act as various to normal feeding or oviposition of insects. It is associated with resistance to many insect pest, that is in cotton to jassids and in turnip to turnip aphid.

ii. Narrowness: Narrowness of the leaves will prevent the oviposition of insects because narrow leaf is not wide enough to place the abdomen of female insect.

iii. Scent: Disagreeable odour may contribute to non preference of plant to insect.

iv. Colour of plant: Plant colour may contribute non preference in some cases. e.g. Red cabbage and red leaved Brussels sprout are less preferable than green varieties by butterflies and certain other lepidoptera for oviposition.

2. Anatomical factors

Large number of vascular bundle and thick hypodermal layer present mechanical obstruction to feeding and oviposition and thereby lead to non preference as well as antibiosis. e.g. Thick leaf lamina in cotton contribute to jassids resistant.

B. Chemical factors

Several chemical factors are known to be associated with insect resistance in many crop. e.g. In rice, high silica content in shoots confers resistance to shoot borer as it causes rapid wearing mandibular mouthparts of these pest. The plants which contain 12-13% silica are resistant to chewing type insect.